

# **The Sustained Ocean Observing System for Climate FY 2007 Annual Report System Management**

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## **Project Summary**

### **Introduction**

The Office of Climate Observation (OCO) is a project office established in 2003 under the auspices of the Climate Program Office (CPO) to manage the ocean sub-capability of the Climate Observations and Analysis Program. NOAA's Climate Goal, via the OCO, provides the backbone of the Global Component of the U.S. Integrated Ocean Observing System (IOOS). IOOS is the U.S. contribution to the international Global Ocean Observing System (GOOS), which is the ocean baseline of the Global Earth Observation System of Systems (GEOSS).

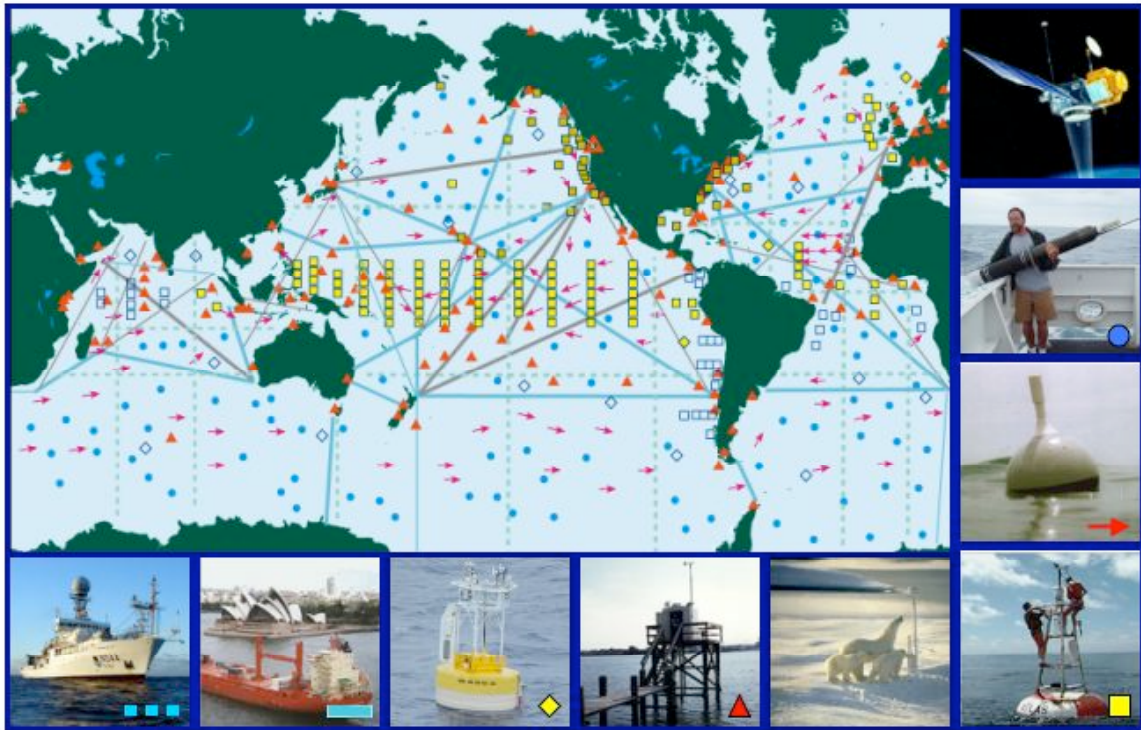


Figure 1. The Networks that make up the Sustained Ocean Observing System for Climate are (from lower left to upper right): Dedicated Ships, Ships of Opportunity, Ocean Reference Stations, Tide Gauge Stations, Arctic Observing Systems, Tropical Moored Buoys, Surface Drifting Buoys, Argo Profiling Floats, and Continuous Satellite Missions for sea surface temperature, sea surface height, surface vector winds, ocean color, and sea ice. Not illustrated are the Data & Assimilation Subsystems and Product Delivery.

It is the job of OCO to advance the multi-year *Program Plan for Building a Sustained Ocean Observing System for Climate*. The intended outcome is a sustained global system of complementary *in situ*, satellite, data, and modeling subsystems adequate to accurately document the state of the ocean and to force climate models. The observing system is being put in place to meet climate requirements but it also supports weather prediction, global and coastal ocean prediction, marine hazard warning systems (e.g., tsunami warning), transportation, marine environment and ecosystem monitoring, and naval applications. Many non-climate users also depend on the baseline composite system that is nominally referred to as the sustained ocean observing system for climate.

### **Responsible Institutions**

The “Networks” are managed by 22 distributed centers of expertise at the NOAA laboratories, centers, joint institutes, universities and business partners. The “System” is centrally managed at the Office of Climate Observation. Specifically, OCO’s tasks are to:

- Monitor the status of the globally distributed networks; report system statistics and metrics routinely and on demand;
- Evaluate the effectiveness of the system; take action to implement improvements through directed funding;
- Advance the multi-year program plan; evolve the *in situ* networks through directed funding;
- Focus intra-agency, interagency, and international coordination;
- Organize external review and user feedback; and
- Produce annual reports on the state of the ocean and the adequacy of the observing system for climate.

The distributed centers of expertise that are implementing NOAA’s contributions to the system are at AOML, PMEL, ESRL, GFDL, JIMAR (University of Hawaii), JIMO (Scripps Institution of Oceanography), CICOR (Woods Hole Oceanographic Institution), JISAO (University of Washington), CIMAS (University of Miami), CICAR (Columbia University), CIFAR (University of Alaska), NCDC, NODC, NGDC, CO-OPS, OMAO, NDBC, NCEP, FSU (Florida State University), LSA, and CLS America. The contributions of these centers of expertise are summarized by the project managers in their individual reports.

Across the NOAA centers and partner institutions there are 49 Federal employees and 119 non-Federal employees working to implement the system. Within the OCO project office there are six Federal employees and one non-Federal; one of the OCO Federal employees is detailed to the JCOMM Secretariat at the international GOOS Project Office at IOC/UNESCO in Paris.

### **Partnerships are central**

A global observing system by definition crosses international and institutional boundaries, with potential for both benefits and responsibilities to be shared by many. In

addition to the work specifically supported through the OCO program, NOS, NMFS, and NWS maintain observational infrastructure for ecosystems, transportation, marine services and coastal forecasting that do or have potential to contribute to climate observation. NOS sea level measurements in particular provide one of the best and longest climate records existent. NESDIS data centers are essential. OMAO ship operations are necessary for supporting the ocean observing system. NESDIS continuous satellite missions are needed to provide remote sensing that complements the *in situ* measurements. All of the OCO contributions to global observation are managed in cooperation internationally with the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM). The National Science Foundation has initiated the Ocean Observatories Initiative, which will potentially provide significant infrastructure in support of ocean climate observation. The ongoing NSF-NOAA cooperative project for CLIVAR-ocean carbon surveys has proved to be an interagency-international-interdisciplinary success. The Office of Naval Research maintains a GODAE data server at Monterey that is critical to global data access. The UNOLS fleet provides ship support for ocean operations. NASA's development of remote sensing techniques is key. The ocean climate research being conducted by the CPO science programs, other NOAA programs, NASA, NSF, and the Navy provides the advancements in knowledge that are essential for continuous system improvement.

## **Mission and Requirements**

The mission of the OCO is to build and sustain a global climate observing system that will respond to the long term observational requirements of the operational forecast centers, international research programs, and major scientific assessments. The focus is on building the *in situ* ocean component. The top-level requirements are to:

- document long term trends in sea level change;
- document ocean carbon sources and sinks;
- document the ocean's storage and global transport of heat and fresh water; and
- document ocean-atmosphere exchange of heat and fresh water.

## **Deliverables**

The ocean climate observing system must have the capability to deliver continuous instrumental records and analyses accurately documenting:

- Sea level to identify changes resulting from climate variability;
- Ocean carbon content every ten years and the air-sea exchange seasonally;
- Sea surface temperature and surface currents to identify significant patterns of climate variability;
- Sea surface pressure and air-sea exchanges of heat, momentum, and fresh water to identify changes in forcing function driving ocean conditions and atmospheric conditions;
- Ocean heat and fresh water content and transports to: 1) identify changes in the global water cycle; 2) identify changed in thermohaline circulation and monitor for indications of possible abrupt climate change; and 3) identify where anomalies

- enter the ocean, how they move and are transformed, and where they re-emerge to interact with the atmosphere; and
- Sea ice thickness and concentrations to identify changes resulting from, and contributing to, climate variability and change.

Present ocean observations are not adequate to deliver these products with confidence. The fundamental deficiency is lack of global coverage by the *in situ* networks. Present international efforts constitute only about 59% of what is needed in the ice-free oceans and 11% in the Arctic. The *Second Report on the Adequacy of the Global Observing System for Climate in Support of the UNFCCC* concludes that “the ocean networks lack global coverage and commitment to sustained operations...Without urgent action to address these findings, the Parties will lack the information necessary to effectively plan for and manage their response to climate change.”

In response to the Second Adequacy Report, international GCOS produced the *Implementation Plan for the Global Observing System for Climate in support of the UNFCCC* (GCOS-92). GCOS-92 was published in October 2004. It has been endorsed by the UNFCCC and by the Group on Earth Observation (GEO). In particular:

1. The UNFCCC, Decision CP.10, “Encourages Parties to strengthen their efforts to address the priorities identified in the [GCOS] implementation plan, and to implement the priority elements ...”
2. The *Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan Reference Document* targets include: “Support implementation of actions called for in GCOS-92.”

OCO’s *Program Plan for Building a Sustained Ocean Observing System for Climate* is in complete accord with GCOS-92 and provides the framework for NOAA contributions to the international effort. In particular 21 of the specific actions listed in the GCOS-92 ocean chapter (pages 56-84) are being acted upon by the OCO program in cooperation with the implementation panels affiliated with the JCOMM. These specific GCOS-92 actions now provide an excellent roadmap to guide observing system work plans. GCOS-92 is accessible via link from the OCO web site: [www.oco.noaa.gov](http://www.oco.noaa.gov) -- click on “Reports & Products.” The work supported by OCO is directed toward implementation of this international plan and the projects are being implemented in accordance with the GCOS Ten Climate Monitoring Principles. The OCO supported projects contributed nearly half of the total international effort in 2007.

## **FY 2007 Accomplishments**

The international global ocean climate observing system overall advanced from 56% complete in 2006 to 59% complete in 2007. Of the 7723 *in situ* platforms maintained globally, 3860 were supported by NOAA. The annual reports of the Project Managers detail the specific advancements of the individual networks.

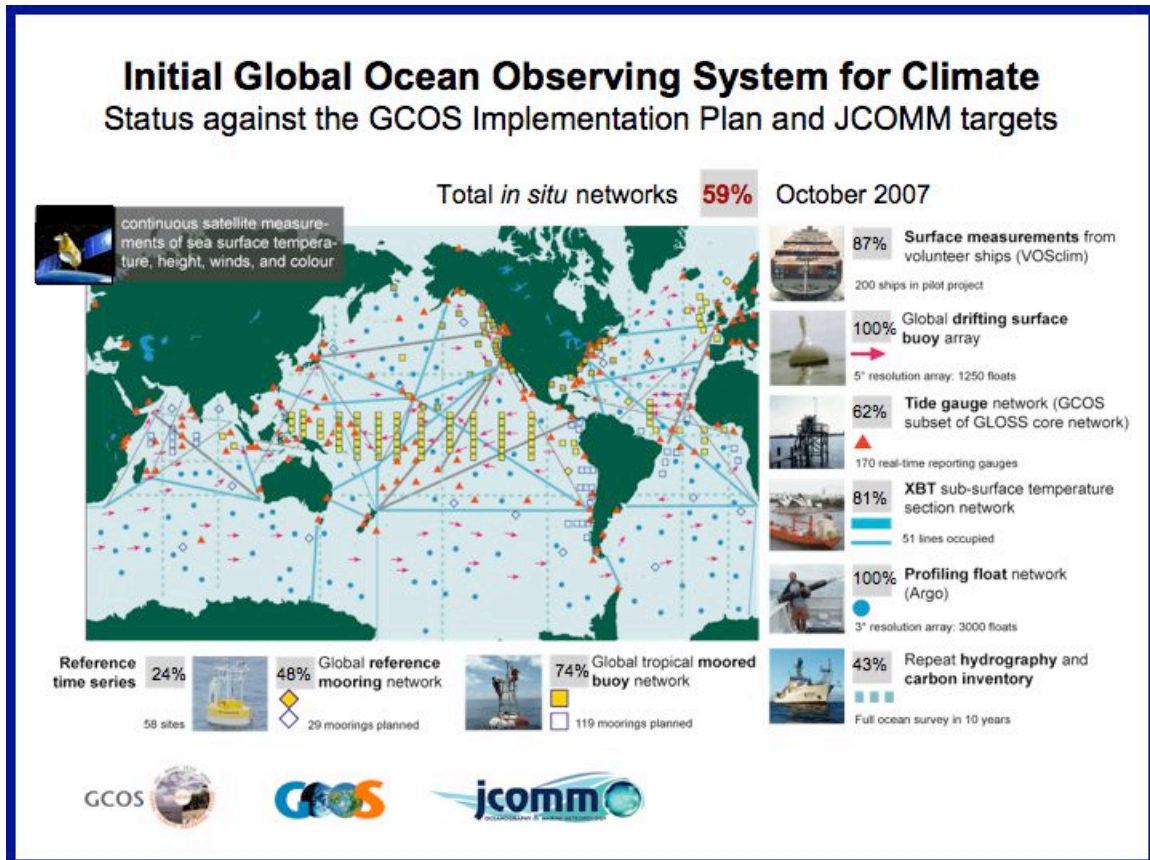


Figure 2: A schematic of the initial composite ocean observing system, including the current status against the targets of JCOMM and the GCOS Implementation Plan (GCOS-92).

The OCO program was reviewed 5-7 June 2007 in Silver Spring. The Fifth Annual System Review brought together 78 project managers, data users, advisors, and program managers both from NOAA and from other partner institutions to discuss system-wide issues and engage in program strategic planning. External review of the program was provided by the Climate Observing System Council (COSC).

The project office was relocated temporarily to the NOAA SSMC campus in November 2006 while the Wayne Avenue facilities were being refurbished and expanded to house other national ocean programs. In July 2007, the project office was re-established at 1100 Wayne Avenue in the expanded facilities and is now co-located with the NOAA IOOS Program office and the National Office for Integrated and Sustained Ocean Observations (Ocean.US).

	<b>Global Ocean Observing System</b>						
	<b>Budget Allocation (\$K)</b>						
	<b>Network</b>	<b>FY 02</b>	<b>FY 03</b>	<b>FY 04</b>	<b>FY 05</b>	<b>FY 06</b>	<b>FY 07</b>
	Tide Gauge Stations	670	710	970	1196	1177	1196
	Drifting Buoys	1699	2077	2769	3130	3427	3130
	Tropical Moored Buoys	3175	3175	3625	4360	3094	3288
	Ships of Opportunity	1960	1903	2487	2907	2776	2804
	Argo Profiling Floats	6978	9706	9811	9491	9758	9796
	Ocean Reference Stations	1983	2357	3271	3244	4205	5336
	Ocean Carbon Networks	1478	2204	2875	3521	3482	3167
	Arctic Ocean Observing Network	1937	4659	3988	5325	5237	3995
	Dedicated Ship Time	0	626	523	92	542	482
	Data & Assimilation Subsystems	2099	1803	3012	2826	1779	1993
	Product Deliver, Analysis/Reanalysis	578	638	896	1982	2048	2580
	Institutional Infrastructure	626	653	1269	1356	711	1344
	<b>Global Systems Total Expenditure</b>	<b>23183</b>	<b>30511</b>	<b>35496</b>	<b>39430</b>	<b>38236</b>	<b>39111</b>
	<b>Funding Distribution</b>						
	NOAA						15923
	External						20213
	Business						1320
	Community Support (workshops, panels, JCOMM, CLIVAR, GOOS)						1655
	<b>Total</b>						<b>39111</b>
	<b>Income Budget Lines</b>						
	OAR Laboratories & Cooperative Institutes				5613	5389	5389
	OAR Climate & Global Change Program				4886	4619	4619
	OAR Climate Observations & Services				28575	24556	25603
	NWS TAO/PIRATA					2695	2959
	Other (one-time supplemental funding)				356	977	541
	<b>Total Income</b>				<b>39430</b>	<b>38236</b>	<b>39111</b>

Table 1: System Funding Record